

# 國立中山大學 103 學年度轉學考招生考試試題

科目名稱：普通生物學【生科系二年級】

題號：721001

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(1)-(50)題為單選題，一題一分。

- 1) What technique would be most appropriate to use to observe the movements of condensed chromosomes during cell division?
  - A) light microscopy
  - B) scanning electron microscopy
  - C) transmission electron microscopy
  - D) confocal fluorescence microscopy
  - E) super-resolution fluorescence microscopy
  
- 2) The extracellular matrix is thought to participate in the regulation of animal cell behavior by communicating information from the outside to the inside of the cell via which of the following?
  - A) gap junctions
  - B) the nucleus
  - C) DNA and RNA
  - D) integrins
  - E) plasmodesmata
  
- 3) According to the fluid mosaic model of cell membranes, which of the following is a true statement about membrane phospholipids?
  - A) They can move laterally along the plane of the membrane.
  - B) They frequently flip-flop from one side of the membrane to the other.
  - C) They occur in an uninterrupted bilayer, with membrane proteins restricted to the surface of the membrane.
  - D) They are free to depart from the membrane and dissolve in the surrounding solution.
  - E) They have hydrophilic tails in the interior of the membrane.
  
- 4) If the sodium ion concentration outside the cell increases, and the CFTR channel is open, in what direction will chloride ions and water move across the cell membrane?
  - A) Chloride ions will move out of the cell, and water will move into the cell.
  - B) Both chloride ions and water will move out of the cell.
  - C) Chloride ions will move into the cell, and water will move out of the cell.
  - D) Both chloride ions and water will move into the cell.
  - E) The movement of chloride ions and water molecules will not be affected by changes in sodium ion concentration outside the cell.
  
- 5) During glycolysis, when each molecule of glucose is catabolized to two molecules of pyruvate, most of the potential energy contained in glucose is
  - A) transferred to ADP, forming ATP.
  - B) transferred directly to ATP.
  - C) retained in the two pyruvates.
  - D) stored in the NADH produced.
  - E) used to phosphorylate fructose to form fructose 6-phosphate.

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- 6) What is the purpose of beta oxidation in respiration?
- A) oxidation of glucose
  - B) oxidation of pyruvate
  - C) feedback regulation
  - D) control of ATP accumulation
  - E) breakdown of fatty acids
- 7) When oxygen is released as a result of photosynthesis, it is a direct by-product of
- A) reducing  $\text{NADP}^+$ .
  - B) splitting water molecules.
  - C) chemiosmosis.
  - D) the electron transfer system of photosystem I.
  - E) the electron transfer system of photosystem II.
- 8) Figure 10.1 shows the absorption spectrum for chlorophyll *a* and the action spectrum for photosynthesis. Why are they different?
- A) Green and yellow wavelengths inhibit the absorption of red and blue wavelengths.
  - B) Bright sunlight destroys photosynthetic pigments.
  - C) Oxygen given off during photosynthesis interferes with the absorption of light.
  - D) Other pigments absorb light in addition to chlorophyll *a*.
  - E) Aerobic bacteria take up oxygen, which changes the measurement of the rate of photosynthesis.
- 9) In which of the following ways do plant hormones differ from hormones in animals?
- A) Plant hormones interact primarily with intracellular receptors.
  - B) Plant hormones may travel in air or through vascular systems.
  - C) Animal hormones are found in much greater concentration.
  - D) Plant hormones are synthesized from two or more distinct molecules.
  - E) Animal hormones are primarily for mating and embryonic development.
- 10) Why is apoptosis potentially threatening to the healthy "neighbors" of a dying cell?
- A) Cell death would usually spread from one cell to the next via paracrine signals.
  - B) Lysosomal enzymes exiting the dying cell would damage surrounding cells.
  - C) Released cellular energy would interfere with the neighbors' energy budget.
  - D) Bits of membrane from the dying cell could merge with neighbors and bring in foreign receptors.
  - E) Neighboring cells would activate immunological responses.
- 11) At the M phase checkpoint, the complex allows for what to occur?
- A) Separase enzyme cleaves cohesins and allows chromatids to separate.
  - B) Cohesins alter separase to allow chromatids to separate.
  - C) Kinetochores are able to bind to spindle microtubules.
  - D) All microtubules are made to bind to kinetochores.
  - E) Daughter cells are allowed to pass into  $G_1$ .

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- 12) A research team began a study of a cultured cell line. Their preliminary observations showed them that the cell line did not exhibit either density-dependent inhibition or anchorage dependence. What could they conclude right away?
- A) The cells originated in the nervous system.
  - B) The cells are unable to form spindle microtubules.
  - C) They have altered series of cell cycle phases.
  - D) The cells show characteristics of tumors.
  - E) They were originally derived from an elderly organism.
- 13) Eukaryotic sexual life cycles show tremendous variation. Of the following elements, which do all sexual life cycles have in common?
- I. Alternation of generations
  - II. Meiosis
  - III. Fertilization
  - IV. Gametes
  - V. Spores
- A) I, IV, and V
  - B) I, II, and IV
  - C) II, III, and IV
  - D) II, IV, and V
  - E) I, II, III, IV, and V
- 14) Which of the following best describes the frequency of crossing over in mammals?
- A) ~50 per chromosome pair
  - B) ~2 per meiotic cell
  - C) at least 1-2 per chromosome pair
  - D) ~1 per pair of sister chromatids
  - E) a very rare event among hundreds of cells
- 15) The individual with genotype  $AaBbCCdEE$  can make many kinds of gametes. Which of the following is the major reason?
- A) segregation of maternal and paternal alleles
  - B) recurrent mutations forming new alleles
  - C) crossing over during prophase I
  - D) different possible alignments of chromosomes
  - E) the tendency for dominant alleles to segregate together
- 16) In each generation of this family after generation I, the age at diagnosis is significantly lower than would be found in nonfamilial (sporadic) cases of this cancer (~ 63 years). What is the most likely reason?
- A) Members of this family know to be checked for colon cancer early in life.
  - B) Hereditary (or familial) cases of this cancer typically occur at earlier ages than do nonfamilial forms.
  - C) This is pure chance; it would not be expected if you were to look at a different family.
  - D) This cancer requires mutations in more than this one gene.
  - E) Affected members of this family are born with colon cancer, and it can be detected whenever they are first tested.

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- 17) Males are more often affected by sex-linked traits than females because
- A) male hormones such as testosterone often alter the effects of mutations on the X chromosome.
  - B) female hormones such as estrogen often compensate for the effects of mutations on the X chromosome.
  - C) X chromosomes in males generally have more mutations than X chromosomes in females.
  - D) males are hemizygous for the X chromosome.
  - E) mutations on the Y chromosome often worsen the effects of X-linked mutations.
- 18) In 1956 Tijo and Levan first successfully counted human chromosomes. What is the reason it took so many years to do so?
- A) Watson and Crick's structure of DNA was not done until 1953.
  - B) Chromosomes were piled up on top of one another in the nucleus.
  - C) Chromosomes were not distinguishable during interphase.
  - D) A method had not yet been devised to halt mitosis at metaphase.
  - E) Chromosomes were piled up on top of one another in the nucleus, chromosomes were not distinguishable during interphase, and a method had not yet been devised to halt mitosis at metaphase.
- 19) Which of the following investigators was/were responsible for the following discovery? In DNA from any species, the amount of adenine equals the amount of thymine, and the amount of guanine equals the amount of cytosine.
- A) Frederick Griffith
  - B) Alfred Hershey and Martha Chase
  - C) Oswald Avery, Maclyn McCarty, and Colin MacLeod
  - D) Erwin Chargaff
  - E) Matthew Meselson and Franklin Stahl
- 20) If a cell were unable to produce histone proteins, which of the following would be a likely effect?
- A) There would be an increase in the amount of "satellite" DNA produced during centrifugation.
  - B) The cell's DNA couldn't be packed into its nucleus.
  - C) Spindle fibers would not form during prophase.
  - D) Amplification of other genes would compensate for the lack of histones.
  - E) Pseudogenes would be transcribed to compensate for the decreased protein in the cell.
- 21) Transcription in eukaryotes requires which of the following in addition to RNA polymerase?
- A) the protein product of the promoter
  - B) start and stop codons
  - C) ribosomes and tRNA
  - D) several transcription factors (TFs)
  - E) aminoacyl synthetase
- 22) In order for a eukaryotic gene to be engineered into a bacterial colony to be expressed, what must be included in addition to the coding exons of the gene?
- A) the introns

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- B) eukaryotic polymerases
- C) a bacterial promoter sequence
- D) eukaryotic ribosomal subunits
- E) eukaryotic tRNAs

23) A mutation that inactivates the regulatory gene of a repressible operon in an *E. coli* cell would result in

- A) continuous transcription of the structural gene controlled by that regulator.
- B) complete inhibition of transcription of the structural gene controlled by that regulator.
- C) irreversible binding of the repressor to the operator.
- D) inactivation of RNA polymerase by alteration of its active site.
- E) continuous translation of the mRNA because of alteration of its structure.

24) If she moves the promoter for the *lac* operon to the region between the *beta galactosidase* gene and the *permease* gene, which of the following would be likely?

- A) Three structural genes will no longer be expressed.
- B) RNA polymerase will no longer transcribe permease.
- C) The operon will no longer be inducible.
- D) Beta galactosidase will be produced.
- E) The cell will continue to metabolize but more slowly.

25) A gene that contains introns can be made shorter (but remain functional) for genetic engineering purposes by using

- A) RNA polymerase to transcribe the gene.
- B) a restriction enzyme to cut the gene into shorter pieces.
- C) reverse transcriptase to reconstruct the gene from its mRNA.
- D) DNA polymerase to reconstruct the gene from its polypeptide product.
- E) DNA ligase to put together fragments of the DNA that code for a particular polypeptide.

26) Scientists developed a set of guidelines to address the safety of DNA technology. Which of the following is one of the adopted safety measures?

- A) Microorganisms used in recombinant DNA experiments are genetically crippled to ensure that they cannot survive outside of the laboratory.
- B) Genetically modified organisms are not allowed to be part of our food supply.
- C) Transgenic plants are engineered so that the plant genes cannot hybridize.
- D) Experiments involving HIV or other potentially dangerous viruses have been banned.
- E) Recombinant plasmids cannot be replicated.

27) Which of the following is most important in making the typical seed more resistant to adverse conditions than the typical spore?

- A) a different type of sporopollenin
- B) an internal reservoir of liquid water
- C) integument(s)
- D) ability to be dispersed
- E) waxy cuticle

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- 28) If one were to erect a new taxon of plants that included all plants that are pollinated by animals, and only plants that are pollinated by animals, then this new taxon would be
- A) monophyletic.
  - B) paraphyletic.
  - C) polyphyletic.
  - D) identical in composition to the phylum Anthophyta.
  - E) identical in composition to the phylum Cycadophyta.
- 29) Plants growing in a partially dark environment will grow toward light in a response called phototropism. Which of the following statements is true regarding phototropism?
- A) It is caused by an electrical signal.
  - B) One chemical involved is ethylene.
  - C) Auxin causes a growth increase on one side of the stem.
  - D) Auxin causes a decrease in growth on the side of the stem exposed to light.
  - E) Removing the apical meristem enhances phototropism.
- 30) Plants often use changes in day length (photoperiod) to trigger events such as dormancy and flowering. It is logical that plants have evolved this mechanism because photoperiod changes
- A) are more predictable than air temperature changes.
  - B) alter the amount of energy available to the plant.
  - C) are modified by soil temperature changes.
  - D) can reset the biological clock.
  - E) are correlated with moisture availability.
- 31) Animals that migrate great distances would obtain the greatest energetic benefit of storing chemical energy as
- A) proteins.
  - B) minerals.
  - C) carbohydrates.
  - D) amino acids.
  - E) fats.
- 32) The absorption of fats differs from that of carbohydrates in that the
- A) processing of fats does not require any digestive enzymes, whereas the processing of carbohydrates does.
  - B) fat absorption occurs in the stomach, whereas carbohydrates are absorbed from the small intestine.
  - C) carbohydrates need to be emulsified before they can be digested, whereas fats do not.
  - D) most absorbed fat first enters the lymphatic system, whereas carbohydrates directly enter the blood.
  - E) fats, but not carbohydrates, are digested by bacteria before absorption.
- 33) The circulatory system of bony fishes, rays, and sharks is similar to
- A) that of birds, with a four-chambered heart.
  - B) the portal systems of mammals, where two capillary beds occur sequentially, without passage of

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blood through a pumping chamber.

- C) that of reptiles, with one pumping chamber driving blood flow to a gas-exchange organ, and a different pumping chamber driving blood to the rest of the circulation.
  - D) that of sponges, where gas exchange in all cells occurs directly with the external environment.
  - E) that of humans, where there are four pumping chambers to drive blood flow.
- 34) Air-breathing insects carry out gas exchange
- A) in their specialized external gills.
  - B) in their specialized internal gills.
  - C) in the alveoli of their lungs.
  - D) across the membranes of their cells.
  - E) across all parts of their thin cuticular exoskeleton.
- 35) The eyes and the respiratory tract are both protected against infections by
- A) the mucous membranes that cover their surface.
  - B) the secretion of complement proteins.
  - C) the release of slightly alkaline secretions.
  - D) the secretion of lysozyme onto their surfaces.
  - E) interferons produced by immune cells.
- 36) Among the last line of defenses against prolonged exposure to an extracellular pathogen is
- A) lysozyme production.
  - B) phagocytosis by neutrophils.
  - C) antibody production by plasma cells.
  - D) histamine release by basophils.
  - E) lysis by natural killer cells.
- 37) Birds that live in marine environments and thus lack access to fresh drinking water
- A) osmoregulate without using a transport epithelium for this purpose.
  - B) drink seawater and secrete excess ions through their kidneys only.
  - C) drink seawater and secrete excess ions mainly through their nasal salt glands.
  - D) have plasma that is isoosmotic to ocean water.
  - E) obtain water by eating only osmoregulating prey.
- 38) Birds secrete uric acid as their nitrogenous waste because uric acid
- A) is readily soluble in water.
  - B) is metabolically less expensive to synthesize than other excretory products.
  - C) requires little water for nitrogenous waste disposal, thus reducing body mass.
  - D) excretion allows birds to live in desert environments.
- 39) Prostaglandins are local regulators whose chemical structure is derived from
- A) oligosaccharides.
  - B) fatty acids.
  - C) steroids.

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- D) amino acids.
- E) nitric oxide.

40) Fight-or-flight reactions include activation of

- A) the parathyroid glands, leading to increased metabolic rate.
- B) the thyroid gland, leading to an increase in the blood calcium concentration.
- C) the anterior pituitary gland, leading to cessation of gonadal function.
- D) the adrenal medulla, leading to increased secretion of epinephrine.
- E) the pancreas, leading to a reduction in the blood sugar concentration.

41) Animals with reproduction dependent on internal fertilization need not have

- A) any copulatory organs.
- B) a receptacle that receives sperm.
- C) behavioral interaction between males and females.
- D) internal development of embryos.
- E) haploid gametes.

42) An oocyte released from a human ovary enters the oviduct as a result of

- A) the beating action of the flagellum on the oocyte.
- B) the force of the follicular ejection directing the oocyte into the oviduct.
- C) the wavelike beating of cilia lining the oviduct.
- D) movement of the oocyte through the pulsating uterus into the oviduct.
- E) peristaltic contraction of ovarian muscles.

43) A human zygote undergoes its first cell division

- A) 5 seconds after fertilization.
- B) 30 minutes after fertilization.
- C) 90 minutes after fertilization.
- D) 4 hours after fertilization.
- E) 24 hours after fertilization.

44) Animal development compares to plant development in that

- A) plant cells, but not animal cells, migrate during morphogenesis.
- B) animal cells, but not plant cells, migrate during morphogenesis.
- C) plant cells and animal cells migrate extensively during morphogenesis.
- D) neither plant cells nor animal cells migrate during morphogenesis.
- E) plant cells, but not animal cells, undergo convergent extension.

45) In a simple synapse, neurotransmitter chemicals are received by

- A) the dendritic membrane.
- B) the presynaptic membrane.
- C) axon hillocks.
- D) cell bodies.
- E) ducts on the smooth endoplasmic reticulum.



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- 46) The botulinum toxin reduces the synaptic release of
- A) acetylcholine.
  - B) epinephrine.
  - C) endorphin.
  - D) nitric oxide.
  - E) GABA.
- 47) The cerebrospinal fluid is
- A) a filtrate of the blood.
  - B) a secretion of glial cells.
  - C) a secretion of interneurons.
  - D) cytosol secreted from ependymal cells.
  - E) secreted by the hypothalamus.
- 48) The blood-brain barrier
- A) is formed by tight junctions.
  - B) is formed by oligodendrocytes.
  - C) tightly regulates the intracellular environment of the CNS.
  - D) uses chemical signals to communicate with the spinal cord.
  - E) provides support to the brain tissue.
- 49) Tastes and smells are distinct kinds of environmental information in that
- A) neural projections from taste receptors reach different parts of the brain than the neural projections from olfactory receptors.
  - B) the single area of the cerebral cortex that receives smell and taste signals can distinguish tastes and smells by the pattern of action potentials received.
  - C) tastant molecules are airborne, whereas odorant molecules are dissolved in fluids.
  - D) distinguishing tastant molecules requires learning, whereas smell discrimination is an innate process.
  - E) odorants bind to receptor proteins, but none of the tastant stimuli bind to receptors.
- 50) The cochlea is an organ of auditory transduction that contains
- A) fluid and cells that can undergo mechanosensory transduction.
  - B) air and cells that produce wax.
  - C) air and small bones that vibrate in response to sound waves.
  - D) fluid with stacks of chemosensory cells.
  - E) air and statocysts activated by movement.

(51)題為問答題，共計 50 分。

51) 請選擇 10 種你平常在自助餐會吃到的生物，說明其：

A) 在分類體系中的歸屬 (taxonomic affiliation)

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- B) 生態角色(niche)
- C) 棲地類型(若是馴化生物，請說明未被人類馴化前的棲地類型)
- D) 所屬生態系 (ecosystem)
- E) 在食物網中的角色 (role in a food web)
- F) 彼此之間最可能的親緣關係(phylogenetic relationships)，以及支持這個親緣關係假說的特徵為何。

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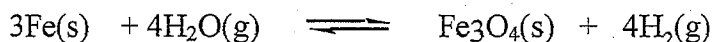
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Part I. Multiple Choice (including single choice) (60%)

- Which statements about bonding molecular orbitals are correct?
  - Electrons in bonding orbitals tend to stabilize the molecule.
  - Only  $\sigma$  bonds can result from bonding molecular orbitals.
  - In a bonding molecular orbital, the electron density is high between the two atoms.
  - Bonding molecular orbitals result from *in phase* overlap of the wave functions of the atomic orbitals.
  - The relative numbers of electrons in bonding versus antibonding orbitals determine the overall stability of the molecule.

- Consider the following reaction



which would be the appropriate equilibrium constant expression: (single choice)

- $\frac{[\text{H}_2\text{O}]^4}{[\text{H}_2]^4}$
- $\frac{[\text{H}_2]^4}{[\text{H}_2\text{O}]^4}$
- $\frac{[\text{Fe}_3\text{O}_4][\text{H}_2]}{[\text{Fe}][\text{H}_2\text{O}]}$
- $\frac{[\text{Fe}_3\text{O}_4][\text{H}_2]^4}{[\text{Fe}]^3[\text{H}_2\text{O}]^4}$
- $\frac{[\text{Fe}]^3[\text{H}_2\text{O}]^4}{[\text{Fe}_3\text{O}_4][\text{H}_2]^4}$

- Nitrogen (atomic mass = 14.0067 amu) has two naturally occurring isotopes. The masses of  $^{14}\text{N}$  and  $^{15}\text{N}$  are 14.003074 and 15.000108 amu, respectively. What is the percent abundance of  $^{15}\text{N}$ ?

- 15.0001%
- 14.0031%
- 99.635%
- 0.365%
- 0.0104%

- The first ionization energy of sulfur (1005 kJ/mol) is less than that of phosphorus (1060 kJ/mol). Reasonable explanations for this fact involve:

- the stability of the half-filled subshell in atomic sulfur.
- pairing of two electrons in one  $3p$  orbital in sulfur atoms.
- the smaller size of sulfur atoms relative to phosphorus atoms.
- the electron-electron repulsion cause the fourth  $3p$  electron in sulfur to be easily removed.
- the larger effective nuclear charge  $Z_{\text{eff}}$  of sulfur atoms

- What are the number of protons, neutrons, and electrons in the  $^{34}_{16}\text{S}^{2-}$  ion.

- 16 p, 18 n, 16 e
- 16 p, 18 n, 14e
- 16 p, 16 n, 19 e
- 16 p, 18 n, 18 e
- 34 p, 16 n, -18 e

- The second law of thermodynamics states:

- The entropy increase for all exothermic processes.
- The enthalpy of the universe always increases in spontaneous processes.
- A spontaneous process always increases entropy.
- $\Delta H < 0$  and  $\Delta S > 0$  for all spontaneous processes
- The entropy of the universe always increases in spontaneous processes.

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7. Consider  $\text{CH}_4$  and  $\text{CF}_4$ . Electronegativities: C = 2.5, H = 2.1, F = 4.0. Which statement is true?

- (a) Both are  $sp^3$  hybridized at carbon.
- (b) The bond angles in  $\text{CF}_4$  are smaller than those in  $\text{CH}_4$ .
- (c) The C-F bonds are more polar than the C-H bonds.
- (d) Both molecules are nonpolar.
- (e) The bond dipoles in  $\text{CF}_4$  are directed toward the fluorine, but those in  $\text{CH}_4$  are directed toward the carbon atom.

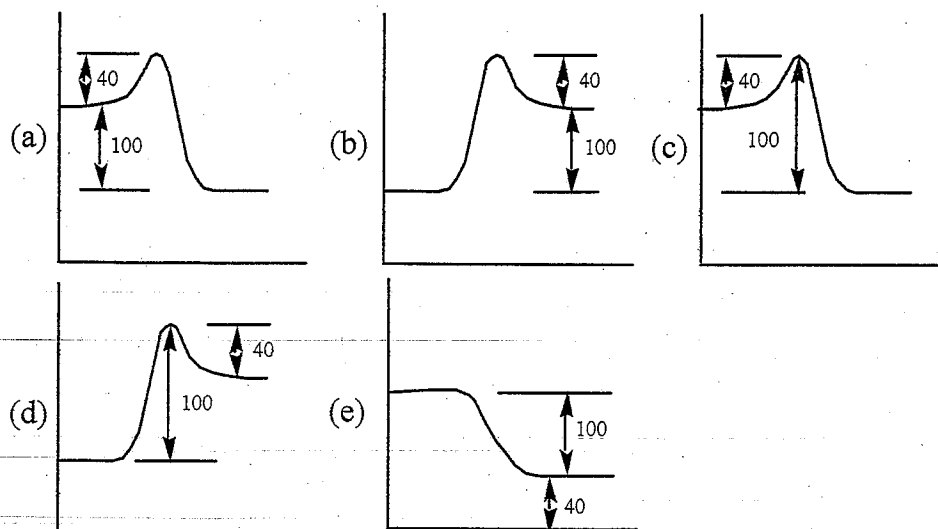
8. What is the bond order for each of the following species:  $\text{N}_2$ ,  $\text{N}_2^-$ ,  $\text{N}_2^+$  and which one would be predicted to have the shortest bond length?

	$\text{N}_2$	$\text{N}_2^-$	$\text{N}_2^+$	
	<u>bond order</u>			<u>shortest bond length</u>
(a)	3	3.5	2.5	$\text{N}_2^+$
(b)	3	2.5	2.5	$\text{N}_2$
(c)	3	4	2	$\text{N}_2^-$
(d)	2	3	1	$\text{N}_2^-$
(e)	3	4	2	$\text{N}_2^-$

9. A catalyst

- (a) increases the amount of products present at equilibrium.
- (b) increases the rate at which equilibrium is reached but decreases the equilibrium constant.
- (c) increases the rate at which equilibrium is reached without changing the equilibrium constant.
- (d) increases  $\Delta H$  for the process.
- (e) lowers the activation energy by changing the reaction pathways.

10. A reaction has an activation energy of 40 kJ and an overall energy change of reaction of  $-100$  kJ. In each of the following potential energy diagrams, the horizontal axis is the reaction coordinate and the vertical axis is potential energy in kJ. Which potential energy diagram best describes this reaction?



背面有題

國立中山大學 103 學年度轉學考招生考試試題

科目名稱：普通化學【生科系二年級】

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11. The gas phase reaction  $A + B \rightarrow C$  has a reaction rate which is experimentally observed to follow the relationship  $\text{rate} = k[A]^2[B]$ . Which one of the following would affect the value of the specific rate constant,  $k$ ?
- (a) increasing the temperature                      (b) changing the concentration of A  
(c) changing the concentration of B                (d) adding a catalyst  
(e) all of the above
12. What volume of  $0.1125\text{ M K}_2\text{Cr}_2\text{O}_7$  would be required to oxidize  $48.16\text{ mL}$  of  $0.1006\text{ M Na}_2\text{SO}_3$  in acidic solution? The products include  $\text{Cr}^{3+}$  and  $\text{SO}_4^{2-}$  ions.
- (a)  $14.36\text{ mL}$                       (b)  $28.75\text{ mL}$                       (c)  $43.12\text{ mL}$   
(d)  $56.12\text{ mL}$                       (e)  $32.15\text{ mL}$
13. For real gas, it follows  $(P + \frac{n^2a}{V^2})(V - nb) = nRT$ . Which one of the statements is true?
- (a) A real gas behaves more nearly as an ideal gas at high temperatures and low pressures.  
(b) In the van der Waals equation, the "a" factor corrects for attractive forces, and one would expect a larger value of "a" for HF than for He.  
(c) The "b" factor in the van der Waals equation should be larger for He than for  $\text{Cl}_2$ .  
(d) Gases approach their liquefaction points as temperature decreases and as pressure increases.  
(e) Both "a" and "b" of the van der Waals equation have values of zero for an ideal gas.
14. About the surface tension, which statements are true?
- (a) The intermolecular interactions among the liquid molecules are responsible for the phenomenon of surface tension.  
(b) The molecules at the surface do not have other molecules on all sides of them and therefore are pulled inwards, which creates internal pressure and forces liquid surfaces to contract to the minimal area.  
(c) Surface tension can also be thought of as the amount of energy required to increase the surface area of a liquid.  
(d) Surface tension is not related to the capillary action.  
(e) From the energy point of view, molecules in the surface area are in the lower energy state than molecules in the interior of a liquid.
15. About proteins, which statements are true?
- (a) The primary structure is the order of the amino acids, which is crucial to the protein's biological function.  
(b) Factors that might affect the tertiary structure of a protein include hydrogen bonds, electrostatic interactions, and hydrophobicity.  
(c)  $\alpha$ -helix and  $\beta$ -sheet are common secondary structures of proteins.  
(d) Heat and pH change can lead to denatured proteins.  
(e) The biological functions of proteins are not affected by their tertiary structure.

背面有題

國立中山大學 103 學年度轉學考招生考試試題

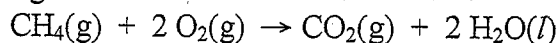
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16. Consider the following reaction occurring at constant pressure and temperature, for which the value of  $\Delta E$  is negative. Which statements are true ?



- (a) Work is done by the surroundings on the system.
- (b) Work is positive.
- (c) Heat is released by the system.
- (d) The volume must increase at constant pressure.
- (e) The reaction is non-spontaneous.

17. The dissolution process is exothermic if the amount of energy released in bringing about  a  interactions exceeds the sum of the amounts of energy absorbed in overcoming  b  and  c  interactions.

	<u> a </u>	<u> b </u>	<u> c </u>
(a)	solute-solute	solvent-solvent	solvent-solute
(b)	solvent-solvent	solute-solute	solvent-solute
(c)	solvent-solute	solute-solute	crystal lattice
(d)	solute-solute	crystal lattice	solvent-solvent
(e)	solvent-solute	solute-solute	solvent-solvent

18. If the concentration of  $\text{CO}_2$  is 2.90 g of  $\text{CO}_2$  per 1.00 L of soft drink when bottled under 2.0 atm of  $\text{CO}_2$  pressure, what will be the concentration of the  $\text{CO}_2$  in the drink after it has been opened and left to come to equilibrium with the atmosphere which has a  $\text{CO}_2$  partial pressure of  $3.0 \times 10^{-4}$  atm?

- (a)  $2.2 \times 10^{-3}$  g  $\text{CO}_2/\text{L}$
- (b)  $2.0 \times 10^{-4}$  g  $\text{CO}_2/\text{L}$
- (c)  $1.0 \times 10^{-4}$  g  $\text{CO}_2/\text{L}$
- (d)  $4.4 \times 10^{-4}$  g  $\text{CO}_2/\text{L}$
- (e)  $4.6 \times 10^{-2}$  g  $\text{CO}_2/\text{L}$

19. What is the mass % solute of a 2.00 molal (※ note: not molar)  $\text{H}_2\text{SO}_4$  solution in water?

- (a) 1.1 %
- (b) 9.8 %
- (c) 19.6 %
- (d) 2.0 %
- (e) 16.4 %

20. Sucrose is a nonvolatile, nonionizing solute in water. Determine the vapor pressure lowering, at  $27^\circ\text{C}$ , of a solution of 75.0 grams of sucrose,  $\text{C}_{12}\text{H}_{22}\text{O}_{11}$ , dissolved in 180.0 g of water. The vapor pressure of pure water at  $27^\circ\text{C}$  is 26.7 torr. Assume the solution is ideal.

- (a) 0.585 torr
- (b) 0.058 torr
- (c) 0.571 torr
- (d) 5.62 torr
- (e) 0.548 torr

21. Which of the following statements regarding a 1 M sucrose solution is **not** correct?

- (a) The boiling point is greater than  $100^\circ\text{C}$ .
- (b) The freezing point is lower than that of a 1 M NaCl solution.
- (c) The freezing point is less than  $0.0^\circ\text{C}$ .
- (d) The boiling point is lower than that of a 1 M NaCl solution.
- (e) The vapor pressure at  $100^\circ\text{C}$  is less than 760 torr.

22. If the van't Hoff factor for NaCl is 1.88, what is the freezing point of a 0.50 molal NaCl solution in water?  $K_f = 1.86^\circ\text{C}/m$  for water.

- (a)  $-0.93^\circ\text{C}$
- (b)  $1.86^\circ\text{C}$
- (c)  $-1.75^\circ\text{C}$
- (d)  $1.75^\circ\text{C}$
- (e)  $-1.86^\circ\text{C}$

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# 國立中山大學 103 學年度轉學考招生考試試題

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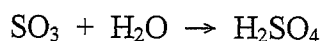
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23. About the color of a coordination compound, which statements are true?
- (a) The color of the complex is the sum of the light absorbed by the complex
  - (b) Besides the types of ligands, the color of a complex also depends on the central metal ion and its oxidation state
  - (c) It is the energy level of the coordination compound that determines at which wavelength the light can be absorbed
  - (d) For complexes with more than one d-electron, there could be several absorption bands
  - (e) Higher oxidation state tends to have larger splitting, therefore altering the color of the complex

24. Which statement regarding the photoelectric effect is correct?
- (a) Electrons can be ejected only if the light is of sufficiently short wavelength.
  - (b) The current increases with increasing intensity of the light.
  - (c) Electrons can be ejected only if the light is of sufficiently high energy.
  - (d) The current does not depend on the color of the light as long as the wavelength is short enough.
  - (e) The wavelength limit sufficient for the ejection of electrons is the same for all metals.

25. The following reaction is partially responsible for acid rain:



Rate data have been determined at a particular temperature for the reaction in which all reactants and products are gases.

<u>Trial Run</u>	<u>Initial [SO<sub>3</sub>]</u>	<u>Initial [H<sub>2</sub>O]</u>	<u>Initial Rate (M•s<sup>-1</sup>)</u>
1	0.35 M	0.35 M	0.150
2	0.70 M	0.35 M	0.600
3	0.35 M	0.70 M	0.300
4	0.70 M	0.70 M	1.20

The rate-law expression is \_\_\_\_\_.

- (a) rate =  $k[\text{SO}_3]^2[\text{H}_2\text{O}]^2$  (b) rate =  $k[\text{SO}_3]^2[\text{H}_2\text{O}]$  (c) rate =  $k[\text{SO}_3][\text{H}_2\text{O}]^2$   
 (d) rate =  $k[\text{SO}_3]^2$  (e) rate =  $k[\text{SO}_3][\text{H}_2\text{O}]$

26. Which statement regarding a stable **heteronuclear** diatomic molecule is true?
- (a) The bonding molecular orbitals have more of the character of the more electronegative element than of the less electronegative element.
  - (b) The antibonding molecular orbitals have more of the character of the more electropositive element than of the more electronegative element.
  - (c) All have bond orders greater than zero.
  - (d) Their molecular orbital diagrams are more asymmetrical than those of homonuclear diatomic molecules.
  - (e) The greater the difference in energy between two overlapping atomic orbitals, the more polar is the bond resulting from the electrons occupying the bonding molecular orbital.

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27. There are two ways that  $C_4H_{10}$  can exist. Which of the following statements about these two forms is false?

- (a) The two forms have the same boiling point.
- (b) The two forms are called constitutional isomers.
- (c) The two forms have the same molecular weight.
- (d) All carbons in both of the two forms have four bonds.
- (e) The two forms are both alkanes.

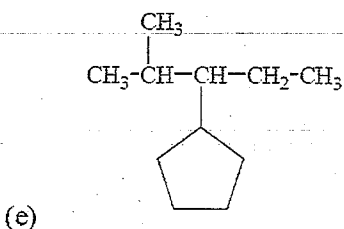
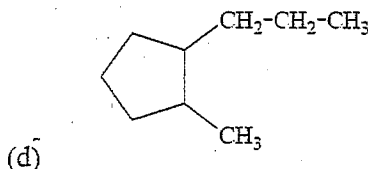
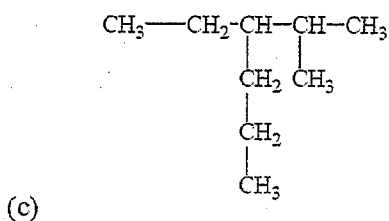
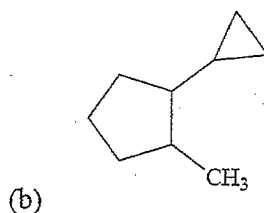
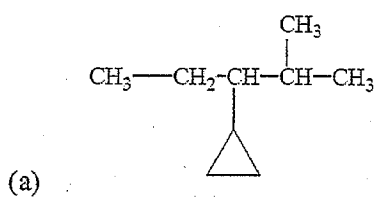
28. Which of the following statements about polyprotic acids is incorrect?

- (a) Polyprotic acids can furnish two or more hydronium ions per molecule.
- (b) It is generally accepted practice to ignore second or third ionizations when calculating the concentration of  $H_3O^+$ .
- (c) The ionizations of polyprotic acids occur simultaneously.
- (d) Successive ionization constants for polyprotic acids generally decrease.
- (e) Phosphoric acid is a typical polyprotic acid

29. Which of the following statements concerning octahedral complexes are correct?

- (a) Strong field ligands produce large crystal field splittings.
- (b) Weak field ligands produce high spin complexes.
- (c) Halide ions are strong field ligands.
- (d) Weak field ligands result in relatively small values for  $\Delta_{Oct}$ .
- (e) A relatively large value for  $\Delta_{Oct}$  causes a complex ion to absorb light with shorter wavelength.

30. Which of the following is the correct structure for 3-cyclopropyl-2-methylpentane?



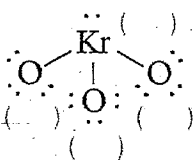


Part II. Non-choice (40%)

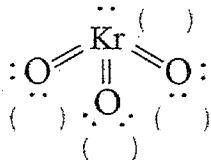
1. (5 %) Following are four of possible Lewis structures for  $\text{KrO}_3$ .

(1) Determine the formal charge of each atom in these four Lewis structures. (4 %)

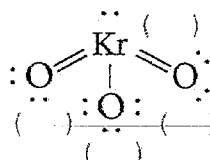
A.



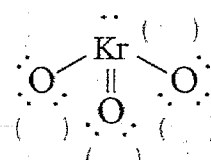
B.



C.

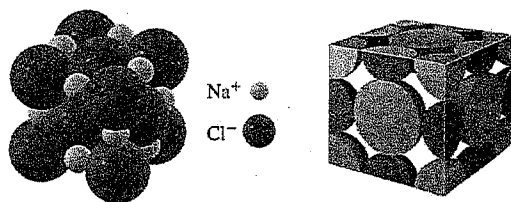


D.



(2) Which Lewis structure is the most likely structure for  $\text{XeO}_3$  (A-D) (1%) ?

2. (10%) For sodium chloride ionic crystal,  $\text{Na}^+$  and  $\text{Cl}^-$  have ionic radius of 1.02 and 1.81 Å, respectively



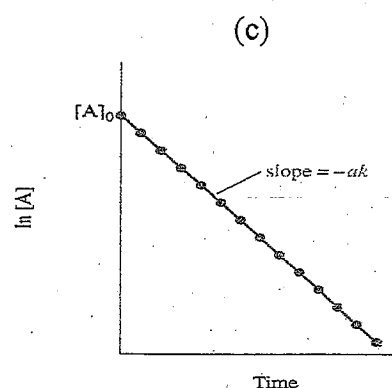
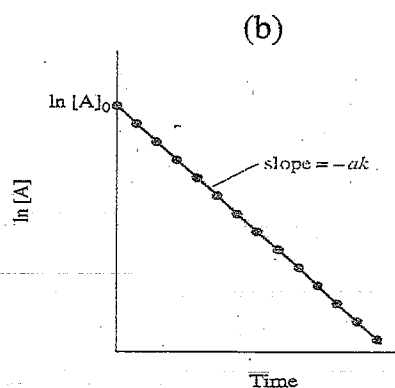
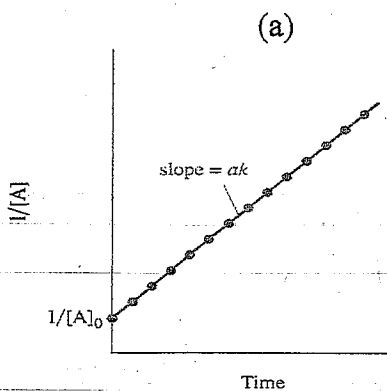
(a) How many  $\text{Cl}^-$  ions surround a  $\text{Na}^+$  ion? (2%)

(b) What is the edge length of each unit cell? (2 %)

(c) What is the shortest distance between two  $\text{Na}^+$  ions? (3 %)

(d) What is the space between two nearest  $\text{Cl}^-$  ions? (3 %)

3. (6 %) For the following graphs, determine their corresponding reaction order:



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4. (10%) An electrochemical cell is constructed at 25 °C as follows: One half-cell consists of the  $\text{Cl}_2/\text{Cl}^-$  with a reduction potential of  $E^\circ = +1.360 \text{ V}$ , and the other half-cell involves the  $\text{MnO}_4^-/\text{Mn}^{2+}$  in acidic solution with a reduction potential of  $E^\circ = +1.507 \text{ V}$ .

(1) Write down the overall reaction for this electrochemical cell. (2 %)

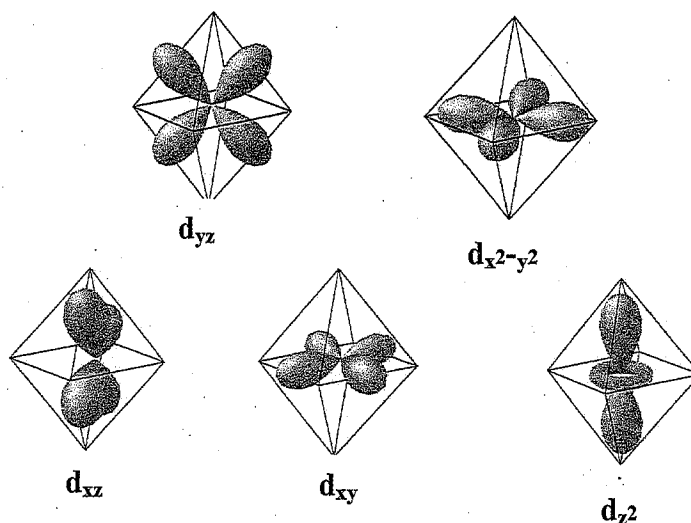
(2) What is the standard potential for this electrochemical cell? (2 %)

(3) What is the standard Gibbs free energy change,  $\Delta G^\circ$ ? (3 %)

(4) Calculate the equilibrium constant  $K$  at 25°C (3 %)

5. (9 %) Crystal field theory treats the ligands as point charges and considers the effect of these point charges on the relative energies of the d orbitals.

Consider the five d orbitals in an octahedral coordination configuration



(a) Which orbitals point their lobes *directly* at the point-charge ligands, and are classified as  $e_g$  orbitals? (2%)

(b) Which orbitals point their lobes *between* at the point-charge ligands, and are classified as  $t_{2g}$  orbitals? (2%)

(c) Which set of orbitals are higher in energy ( $e_g$  or  $t_{2g}$ )? Please explain why? (2%)

(d)  $\text{F}^-$  is a relatively weak ligand, sketch the electron configuration of d electrons for  $[\text{CoF}_6]^{3-}$  and specify the number of unpaired electron (3%)